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TRAJNOST BUŠAĆEG DLETA ZA USLOVE RUDNIKA „ŽUTA PRLINA"

Izvod

Sagledavajući ovu problematiku, ovim radom učinjen je pokušaj, da se za radnu sredinu rudnika Žuta Prlina, eksperimentalno ,,in situ" pri bušenju kratkih minskih bušotina odredi potrošnja bušećeg pribora. Podaci su grupisani u tri grupe u zavisnosti od pritiska sabijenog vazduha i vode. U svakoj grupi posebno su posmatrani uticaji pojedinih elemenata sečiva dleta i njihov uticaj na potrošnju bušećeg dleta.

Ključne reči: *bušeće dleto, trajnost bušećeg dleta, pritisak sabijenog vazduha, pritisak vode*

UVOD

U dodiru sa stenama i čvrstim mineralnim sirovinama, radni elementi mehanizovanog alata i mašina izloženi su, ne samo mehaničkim naprezanjima, nego i velikom trenju između površina materijala radnog elementa i površine mineralnih sastojaka radne sredine. Ovo se podjednako odnosi na sečiva dleta za perkusivno bušenje, krune za rotaciono bušenje, ozubljene valjke za dubinsko rotaciono bušenje itd. Kao posledica pojačanog trenja među površinama dolazi do odnošenja čestica sa istaknutih delova radnog elementa za bušenje. Tako da za kraće ili duže vreme prvobitni geometrijski oblik i dimenzije radnog elementa se menjaju, tj. dolazi do tupljenja sečiva, smanjenja prečnika radnog elementa, a ovim sporije ili brže opadanje njihove radne sposobnosti.

Radi poboljšanja procesa bušenja teži se da se pored povećanja brzine bušenja smanji habanje i poveća izdržljivost reznih elemenata. Pri tome, jedan od osnovnih uslova za optimalan rad bušeće opreme je poznavanje svojstva i kvaliteta reznih elemenata i njihove izdržljivosti, naročito za slučaj bušenja u abrazivnim stenskim sredinama.

Abrazivnost je veoma važan faktor pri procesu bušenja i može se definisati kao osobina stena da izazivaju habanje (trošenje radnih elemenata pri radu). Pri oceni postupka za određivanje abrazivnosti nailazi se i na teškoće s obzirom na složenost

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problema, to je pre svega činjenica da abrazivnost ne zavisi samo od fizičko-mehaničkih osobina radne sredine već isto tako i od tehničkih činilaca, tj. od mehaničke opreme za bušenje i od režima rada i efikasnosti izvođenja radova u procesu bušenja.

HABANJE SEČIVA

Kod bušenja u steni dolazi do habanja sečiva po visini i prečniku, odnosno povećava se površina sečiva. Povećanje površine sečiva izaziva dodatna opterećenja na dletu, što je često uzrok loma sečiva ili tela monoblok dleta. Da bi se monoblok dleto održalo u dobrom, radnom stanju treba ga oštriti preporučenim postupcima od strane proizvođača čime se ostvaruju uštede u tvrdoj leguri i do 50%. Kod bušenja u jako abrazivnim stenama, kao na primer u kvarcitima, dolazi do pojačanog habanja krajnjih ivica sečiva usled čega se smanjuje prečnik glave monoblok dleta. To izaziva obrazovanje „suprotnog konusa" koji deluje kao klin, pa je sečivo, a i celo monoblok dleto izloženo velikim dodatnim opterećenjima, koja neminovno dovode do loma sečiva ili usadnog dela dleta.

Kod bušenja vrlo tvrdih a žilavih materijala (magnetit, krečnjak) na površini sečiva obrazuje se mreža finih pukotina (dubine oko 0,1 mm) koje nastaju usled dinamičkih naprezanja. Kako se u mekom materijalu tvrda legura gotovo i ne troši to se ova mreža ne gubi nego se u toku rada pukotine sve jače produbljuju, dok ne postignu dubinu za iniciranje efekata zareza i do raslojavanja pločice. Međutim, ako se monoblok dletom, čije sečivo ima izraženu „reptilski kožu", buši u abrazivnoj sredini „reptilska koža" nestaje trenutno, tako da ne može doći do oštećenja sečiva.

Osim prirodnih karakteristika na trajnost bušećeg dleta utiču još i tehnički faktori koji su sadržani u kvalitetu čelika od koga je izgrađeno bušeće dleto, od geometrije i oblika bušeće krune, ojačanja bušeće krune, kvaliteta spoja tvrde legure sa maticom krune, zatim disciplina održavanja krune i temena usadnika bušećeg dleta. Svi ovi činioci utiču na trajnost bušećeg dleta, te je preporučljivo uslovima bušenja prilagoditi oblik, dimenzije i kvalitet bušeće krune, zatim posvetiti pažnju uslovima i režimu rada, kao i pridržavati se upustva proizvođača u vezi kontrole stanja bušećeg dleta i njihovog održavanja.

METODOLOGIJA ISTRAŽIVANJA

Ova istraživanja obavljena su u jami „Žuta Prlina" na horizontima 1080 m i 1130 m. Odabrano je po 5 mernih mesta na svakom horizontu, što ukupno čini 10 mernih mesta. Na svakoj mernoj tački vršeno je bušenje bušećim čekićem RK-28 i potpornom nogom tipa RPH-1300. Ispitivanje je vršeno sa uglovima oštrenja 90^o, 100^o, 105^o, 110^o i 120^o i različite pritiske sabijenog vazduha i vode, dužina bušećeg dleta iznosila je l = 1,4 m. Ukupna dužina bušenja, za koju se statistički obrađuje promena iznosi 20 x 1,4 što čini na svakoj mernoj tački 28 m. U toku čitavog bušenja radio je isti radnik, po kvalifikaciji VKV rudar. Merenje je vršeno pomoću specijalnog mernog instrumenta sa komparaterom tačnošću od 0,01 mm. Statističkom obradom podataka dobijene su srdenje vrednosti smanjenja kako po visini tako i po prečniku prvo za merni horizont a zatim za rudno telo. Ove vrednosti poslužile su za donošenje zaključka o trošenju monoblok dleta u ispitivanim uslovima.

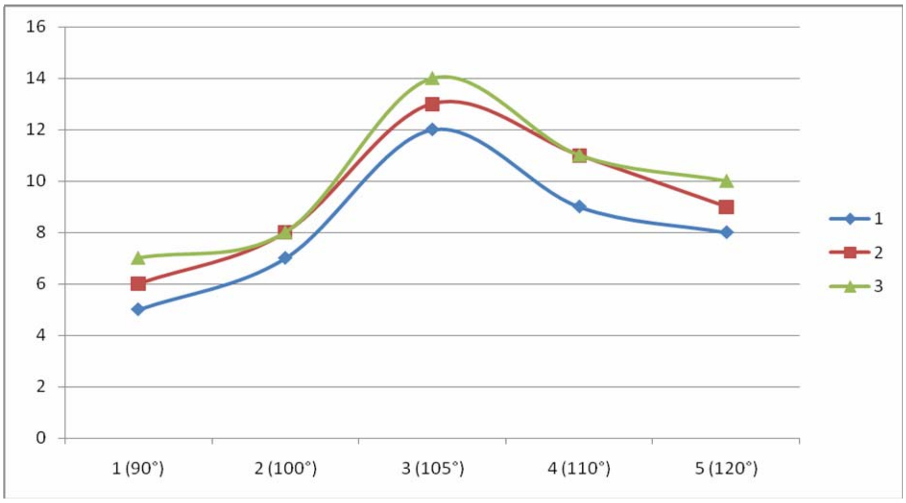
ANALIZA UTICAJNIH ČINILACA NA TRAJNOST BUŠAĆEG DLETA

U radu je obrađena problematika veka trajanja bušećeg dleta, sa posebnim osvrtom na broj oštrenja koja se najčešće javljaju u praksi i rezultate koji se postižu u rudniku gde je obavljeno istrazivanje. Isto tako u radu je data analiza rezultata kojima je utvrdjena zakonitost trošenja bušaćih dleta u zavisnosti od broja izbušenih bušotina.

Ukupna trajnost dleta pri različitim uglovima oštrenja i različitim pritiscima vode i vazduha je različita. Na osnovu eksperimantalnih istraživanja u rudnom telu rudnika „Žuta Prlina” utvrđen je broj oštrenja do granične visine tvrdog metala, koji je na osnovu iskustva pri udarnom bušenju u ovom rudnom telu usvojen da iznosi 7 mm. Na ovaj način određeno je koliki je broj oštrenja, a njime i koliko se ukupno metara bušotina može izbušiti za vek trajanja dleta, posle čega je isto za bušenje neupotrebljivo. Broj oštrenja do potpune istrošenosti dleta za posmatrane uglove oštrenja dleta, dobijeni ovim istraživanjem dati su u tabeli 1 i 2.

Tabela 1. *Pregled broja oštrenja u toku eksperimentalnog bušenja*

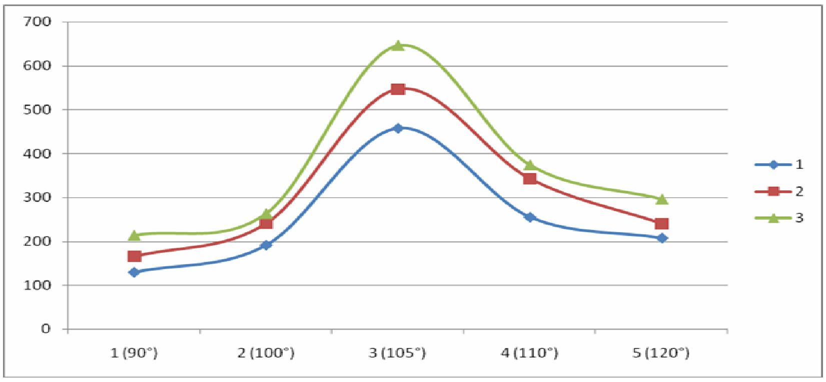
Oznaka	**Pritisak vazduha**	**Broj oštrenja**				
	Vode	**90°**	**100°**	**105°**	**110°**	**120°**
1.	$\frac{4.5 \cdot 10(Pa)}{1 \cdot 10(Pa)}$	5	7	12	9	8
2.	$\frac{5 \cdot 10(Pa)}{1.5 \cdot 10(Pa)}$	6	8	13	11	9
3.	$\frac{6 \cdot 10(Pa)}{2 \cdot 10(Pa)}$	7	8	14	11	10



Sl. 1. *Grafički prikaz broja oštrenja*

Tabela 2. Pregled izbušenih metara u toku eksperimentalnog bušenja

Oznaka	Pritisak vazduha / Vode	Dužina izbušenih metara L(m')				
		90°	100°	105°	110°	120°
1.	$\frac{4.5\cdot 10(Pa)}{1\cdot 10(Pa)}$	130.0	191.8	458.4	255.6	208.0
2.	$\frac{5\cdot 10(Pa)}{1.5\cdot 10(Pa)}$	166.2	241.6	547.3	343.2	241.2
3.	$\frac{6\cdot 10(Pa)}{2\cdot 10(Pa)}$	213.5	263.2	646.8	374.0	296.0



Sl. 2. *Grafički prikaz izbušenih metara*

ZAKLJUČAK

Pod trajnošću bušaćeg dleta podrazumeva se dužina izbušene bušotine posle koje bušaće dleto postaje neupotrebljivo. Istraživanja u ovom radu pokazuju da od mehaničke karakteristike stenske mase u najvećoj meri zavisi trajnost bušaćeg dleta.

Dobijeni podaci, u pogledu veka trajanja bušaćeg dleta, pokazuju da je moguće planirati sa visokom tačnošću potrošnju bušaćih dleta u zavisnosti od uslova pod kojima se bušenje obavlja. Isto tako vidi se da je moguće utvrditi, posle koliko izbušenih metara bušeće dleto treba podvrći kontroli i oštrenju. Ovi podaci, ne samo da su interesantni za nauku, već su interesantni za proizvođače bušećih dleta i nabavnu službu na rudniku, jer im omogućava da blagovremeno obezbede potrebne količine bušećih dleta u proizvodnji.

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DURABILITY IF DRILLING CHISEL FOR REQUIREMENTS OF THE MINE "ŽUTA PRLINA"

Abstract

Considering this problem, an attempt is done by this paper to determine consumtion of drilling tools for the work environment in the mine Žuta Prlina, experimentally "in site" during the short blast holes drilling. Data are grouped into three groups depending on the pressure of compressed air and water. In each group, particularly the impacts of somel elements of bit blade are observed and their impact on consumption the drill bit.

Keywords: *drill bit, drill bit durability, compressed air pressure, water pressure*

INTRODUCTION

In contact with rocks and solid mineral resources, the operating elements of mechanized tools and machines are exposed, not only to the mechanical stresses, but also to high friction between the material surface of work elements and surface of mineral constituents of the working environment. This equally refers to drill bit blades for percussive drilling, rotary drilling, tooth rollers for deep rotary drilling and so on. As the result of increased friction between the surfaces it leads to removal of particles from important parts of work elements of drilling. So, for short or long period the original geometrical shape and dimensions of the working elements are changed, i.e. it comes to dulling of blades, diameter reduction of the working element, and this results into slower or faster decline work capacity.

To improve the drilling process it tends to, beside higher drilling speed, reduce wear and increase durability of cutting elements. In fact, one of the basic conditions for working optimum of drilling equipment is knowledge of the properties and quality of cutting elements of their endurance, especially in the case of rock drilling in abrasive environments.

Abrasiveness is a very important factor in the process of drilling and can be defined as properties of rocks to cause the wearing out (consumtion of working elements at work). In the evaluation process

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for determination of abrasiveness there are difficulties due to the complexity of the problem, it is primarily the fact that abrasiveness depends not only on the physical and mechanical characteristics of the working environment, but also on technical factors, ie. on mechanical drilling equipment and the mode and efficiency of work within the drilling process.

BLADE WEAR

In rock drilling, the blade is worn in height and diameter, i.e. the blade surface is increased. Increasing the blade surface causes an additional load on the bit, which is often the cause of blade breakage or body of drill bit monoblock. To keep drill bit monoblock in a good working condition, it should be sharpened by recomended instructions of producer which can result in savings in hard alloys and up to 50%. When drilling in very abrasive rocks, such as in quartzite, there is increased wear of blade edges which reduces the diameter of head of drill bit monoblock. This causes creation of "opposite cone" that acts as a wedge, and the blade, and the whole bowl gouge is exposed to a large additional loads, which inevitably lead to blade breakage or threaded parts chisels.

In drilling of very hard and tough materials (magnetite, limestone) on the surface of blade is formed a network of fine cracks (depth of about 0.1mm) that arise due to dynamic stresses. Since solid alloy is almost not spent in a soft material, this network is not lost but during the work these cracks are growing deeper, until they reach a depth of initiation point and the effects of stratification tiles. However, if momoblok is drilled with bit whose blade has a visible "reptilian skin" in abrasive environment, the "reptilian skin" disappears instantly, so it can not damage the blade.

In addition to the natural characteristics, durability of drill bit performance is influenced by technical factors that are contained in the quality of steel which the drill bit is made of, drill geometry and shape of drill bit, reinforcement of drill bit, hard alloy quality connection with the main bit, maintenance the drill bit and head of drill bit. All these factors affect the durability of drill bit, and drilling conditions, it is advisable to adjust the shape, size and quality of drill bits, then pay attention to the conditions and mode, as well to comply with the instructions of manufacturer regarding to the control of drill bit condition and maintenance.

TESTING METHODOLOGY

This testing was performed in the pit Žuta Prlina at levels of 1080 m and 1130 m. Selected by 5 measuring points at each level, making total of 10 stations. At each measuring point the drilling was done with a drill hammer RK-28 and RPH-1300. Testing was performed with sharpening angles of 90^0, 100^0, 105^0, 110^0 and 120^0 and various pressures of compressed air and water, the length of drill bit was l = 1.4 m. Total length of drilling for which the change is statistically processes is 20 x 1.4, what is each measuring point 28 m. The same worker, skilled miner, worked during drilling. Measurement was done using a special measuring device with comparator, accuracy of 0.01 mm. Statistical analysis of data resulted into average values of reduction in height and diameter by the first measurement of level and then the ore body. These values were used to draw conclusions about spending the drill bit monoblock in tested conditions.

ANALYSIS OF INFLUENTIAL FACTORS ON DURABILITY OF DRILL BIT PERFORMANCE

This paper deals with the life of the drill bit, with special reference to the number of sharpening that occurs most frequently in practice and performance of the mine where testing was performed. Also, the paper presents an analysis of the results that verify the way of consumption the drill bits depending on the number of drilled holes.

Total duration of drill bit at different sharpening angles and different pressures of water and air is different. Based on the experimental testing in the ore body of the mine Zuta Prlina, it was identified that a number of sharpening to the limit height of hard metal, which is, based on the experiences of the impact of drilling in this mine, is adopted to 7mm. In this way, the number of sharpening was determined, and how many meters of drill holes could be drilled for the life of bit, after which the same drill is unusable. Number of sharpening to the complete worn out for the observed sharpening angles, obtained in this testing are given in Tables 1 and 2.

Table 1. *Overview of sharpening number during experimental drilling*

Designation	**Air pressure / Water**	**Number of sharpening**				
		90^0	**100^0**	**105^0**	**110^0**	**120^0**
1	$\frac{4.5\cdot 10(Pa)}{1\cdot 10(Pa)}$	5	7	12	9	8
2	$\frac{5\cdot 10(Pa)}{1.5\cdot 10(Pa)}$	6	8	13	11	9
3	$\frac{6\cdot 10(Pa)}{2\cdot 10(Pa)}$	7	8	14	11	10

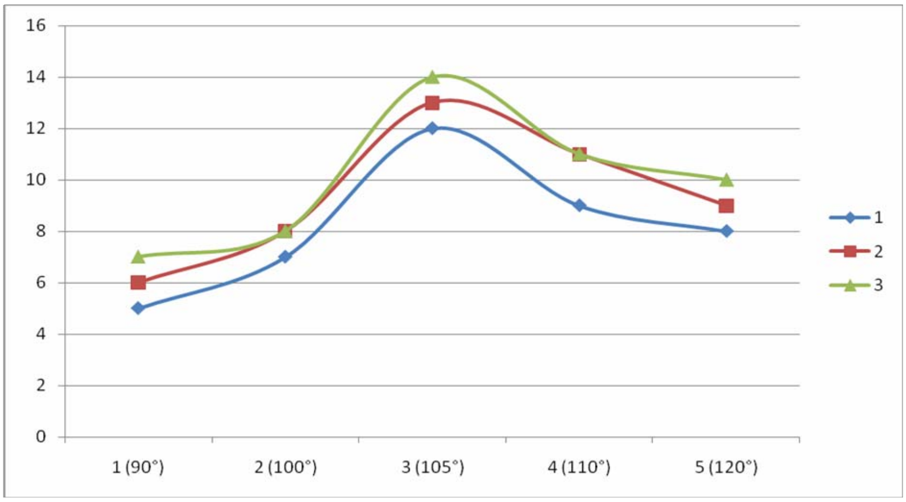

Fig. 1. *Graphic presentation the number of sharpening*

Table 2. *Overview of drilled meters during experimental drilling*

Mark	Air pressure	Length of drilled meters				
	Water	**90^0**	**100^0**	**105^0**	**110^0**	**120^0**
1	$\frac{4.5\cdot10(Pa)}{1\cdot10(Pa)}$	130.0	191.8	458.4	255.6	208.0
2	$\frac{5\cdot10(Pa)}{1.5\cdot10(Pa)}$	166.2	241.6	547.3	343.2	241.2
3	$\frac{6\cdot10(Pa)}{2\cdot10(Pa)}$	213.5	263.2	646.8	374.0	296.0

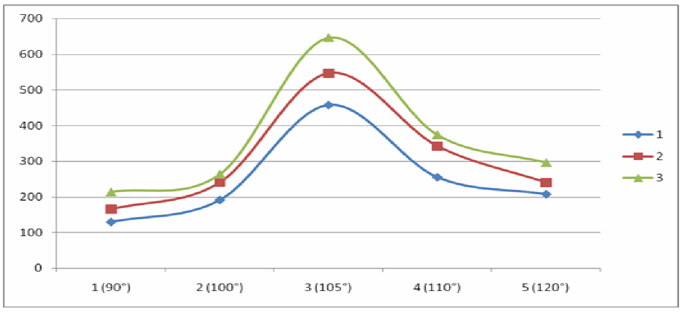

Fig. 2. *Graphic presentation the drilled meters*

CONCLUSION

Term durability of drill bit means the length of the drilled hole after which it becomes unusable. Researches in this paper show that the durability of drill bit depends mainly on mechanical properties of the rock mass.

The obtained data, in terms of the life of drill bit, show that it is possible to plan the consumption of drill bits with high accuracy depending on the conditions under which the drilling is done. It also shows that it is possible to determine, after how many drilled meters the drill bit should be subjected to control and sharpening. These data are not only of interest for the science, but they are interesting for manufacturers of drill bits and acquisition department in the mine, allowing them to provide timely the required amount of drill bit in production.

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